SMART FARMER - IOT ENABLED SMART FARMING APPLICATION

NALAIYA THIRAN PROJECT

Submitted by

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PROJECT REPORT

CHAPTER 1 - INTRODUCTION

1.1 Project Overview

Any economic development has always been based on agriculture. Agriculture needs to be connected with contemporary practises and technologies to support future growth. Technology can be employed in farming to make farmers' tasks easier to complete given its widespread adoption. Numerous personal assistant devices now make use of electronics and IoT. This can be applied to many important industries, such as agriculture, where their assistants might assist in resolving several problems. Devices can use electronics to evaluate and gather data, as well as to link physically to their operational environment. IoT can assist with data analysis and transmission to the user. When these are combined, an all-in-one tool that can perform a task is created.

1.2 Purpose

Farmers have recently had difficulty anticipating the ideal weather conditions to start farming due to the unpredictable weather and climatic fluctuations. Although it appears unexpected at first glance, crop planning may be done by using certain characteristics to forecast it. It's crucial to maintain farmland both during and after agriculture. Temperature, humidity, and soil moisture measurements can be used to carry out these.

Physical sensors are used in the measurement of these properties. This technology is linked to an IoT system, which can offer farmers a simple interface to read, evaluate, and act based on

the situation as it is now. A step further, the technology may automate the operation of motors and other electrical farming equipment by gaining access to them. This can aid in assuring accuracy and faster response times during unattended operation.

CHAPTER 2 - LITERATURE SURVEY

2.1 Existing problem

Various approaches and solutions have been made to assist farmers in implementing technology methods. Only a few solutions had their performance constrained by suggestions and alerts. While few used independent electronics for IoT. Below is a brief description of a few examples of earlier attempts and studies.

i. IoT-based smart sensors farm stick for real-time temperature and moisture monitoring using solar power, the cloud, and Arduino. Things Speak, a cloud computing platform, was used for this work's data collecting. DHT 11 sensors and an Arduino board were used to create the circuit.

ii. IoT-based smart farming is a way to monitor farming conditions in the best way possible. The ESP-32 based IoT platform and Blynk mobile application were employed in this experiment.

iii. “Smart farming using IoT”. The automation and interface part made use of water pump and HTTP protocol for parameters monitoring using website.

The aforementioned earlier works were missing one or two elements that, if present, could have improved performance. In the first project, switching to a Raspberry Pi-based controller from an Arduino-based one can assist shrink the design space while also giving the microcontroller more UI and IoT interfaces. In the second mentioned project, switching from the Blynk application to the MIT app inventor can increase the likelihood of feature extension. In order to add new features, farmers or developers won't need to purchase a commercial edition of the software.

In the third piece of work, servo-based water valves are used instead of bi-stated logic to improve the control of water pumps by directing and controlling the flow of water.

2.2 References

The following were the source of references:

i. https://www.researchgate.net/publication/313804002_Smart_farming_IoT_based_smart_sensors_agriculture_stick_for_live_temperature_and_moisture_monitoring_using_Arduino_cloud_computing_solar_technology.

ii. "Smart Farming Using IOT", CH Nishanthi; Dekonda Naveen, Chiramdasu Sai Ram , Kommineni Divya , Rachuri Ajay Kumar; ECE Dept., Teegala Krishna Reddy Engineering College, Hyderabad, India 2,3,4,5student, ECE Dept., Teegala Krishna Reddy Engineering College, Hyderabad, India.

iii. "Smart farming: IoT based smart sensors agriculture stick for live temperature and moisture monitoring using Arduino, cloud computing & solar technology", Anand Nayyar Assistant Professor, Department of Computer Applications & IT KCL Institute of Management and Technology, Jalandhar, Punjab Er. Vikram Puri M.Tech(ECE) Student, G.N.D.U Regional Center, Ladewali Campus, Jalandhar

iv. "Smart Farming using IoT, a solution for optimally monitoring farming conditions", Jash Doshi; Tirth kumar ; Patel Santosh kumar Bharati.

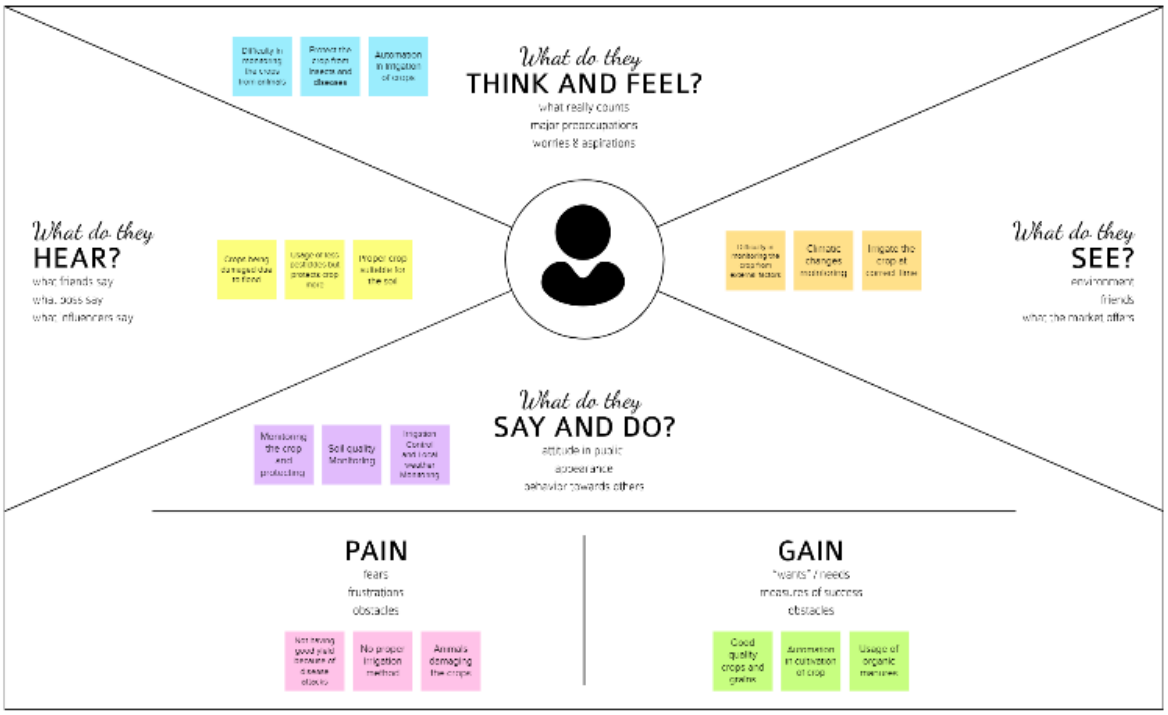
2.3 Problem Statement Definition

In a nutshell, the issue statement encompasses all the technological elements that a farmer may use to transform farming into smart and effective farming. On a larger scale, IoT-enabled smart farming focuses on integrating all the separately operational farming automation sub-systems into a unified entity. The farmer may monitor several field characteristics, such as soil moisture, temperature, and humidity, using an IoT-based agriculture system.

With the use of mobile and online applications, the IoT concept is further expanded so that farmers can keep track of all sensor values even while they are far from their fields. One of the crucial tasks for farmers is to water the crops. They can make the decision whether to water the crop or postpone it by monitoring the sensor parameters and controlling the motor pumps from the mobile application itself.

CHAPTER 3 - IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

Top 3 ideas:

Top 1st:

Name: HARSHAVARDHINI B

Idea name: For farming parameters, a user-friendly programme

Description: A complete application with sophisticated features to monitor all the field parameters and making it user friendly so that every farmer can benefit from that.

Top 2nd:

Name: KRISHNAKANTH M.E

Idea name: A product and feature guide on the internet

Description: A website that describes the features of the application, also provides important advices in farming regarding optimum conditions, crop health, use of resources etc. With this, along with farmers any hobbyist who is interested in farming can start cultivating in an efficient way with this guide.

Top 3rd:

Name: HARISH R

Idea name: Raspberry pi usage for IoT applications as opposed to using another processor

Description: for real time monitoring and high processing power, usage of raspberry pi is a better choice over Arduino and other microcontrollers. And to utilize IoT related applications, raspberry pi platform is the best choice.

16 ideas from the brain storming session

HARSHAVARDHINI B

Idea 1:	User friendly application for farmland parameters
Idea 2:	Awareness about IoT in agricultural domain through various applications
Idea 3:	Computer vision for detecting crop diseases
Idea 4:	Automating watering process to save water

KRISHNAKANTH M.E

Idea 1: Usage of raspberry pi over other processor for IoT applications.

Idea 2: Deciding the specification of sensors to be deployed based on the range of operation per square feet of farmlands.

Idea 3: Protection case for sensors to avoid wear and tear during adverseconditions.

Idea 4: Using RF based communication along with IoT protocols to deliver data.

HARISH R

Idea 1: A website guide about the product and features

Idea 2: Provision through application to remotely control agricultural instruments

Idea 3: Data collection about various field parameters

Idea 4: Features in website to control agricultural actuators

MOHAMMED ANEESUDDIN J

Idea 1: Various protocols used in IoT.

Idea 2: Application with simple UI but efficient usage.

Idea 3: Interface between website, application and sensors.

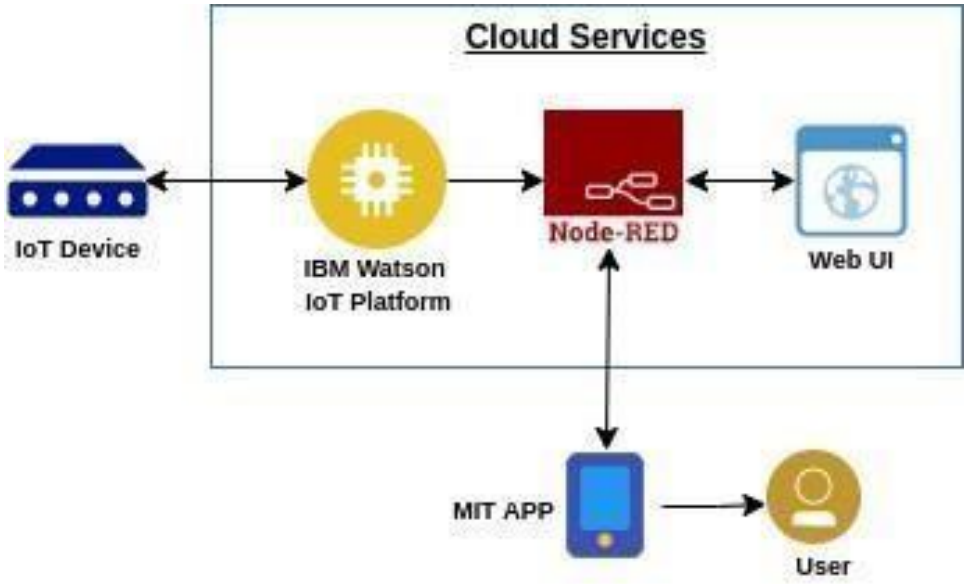
Idea 4: Utilizing ai to improvise accuracy.

3.3 Proposed Solution

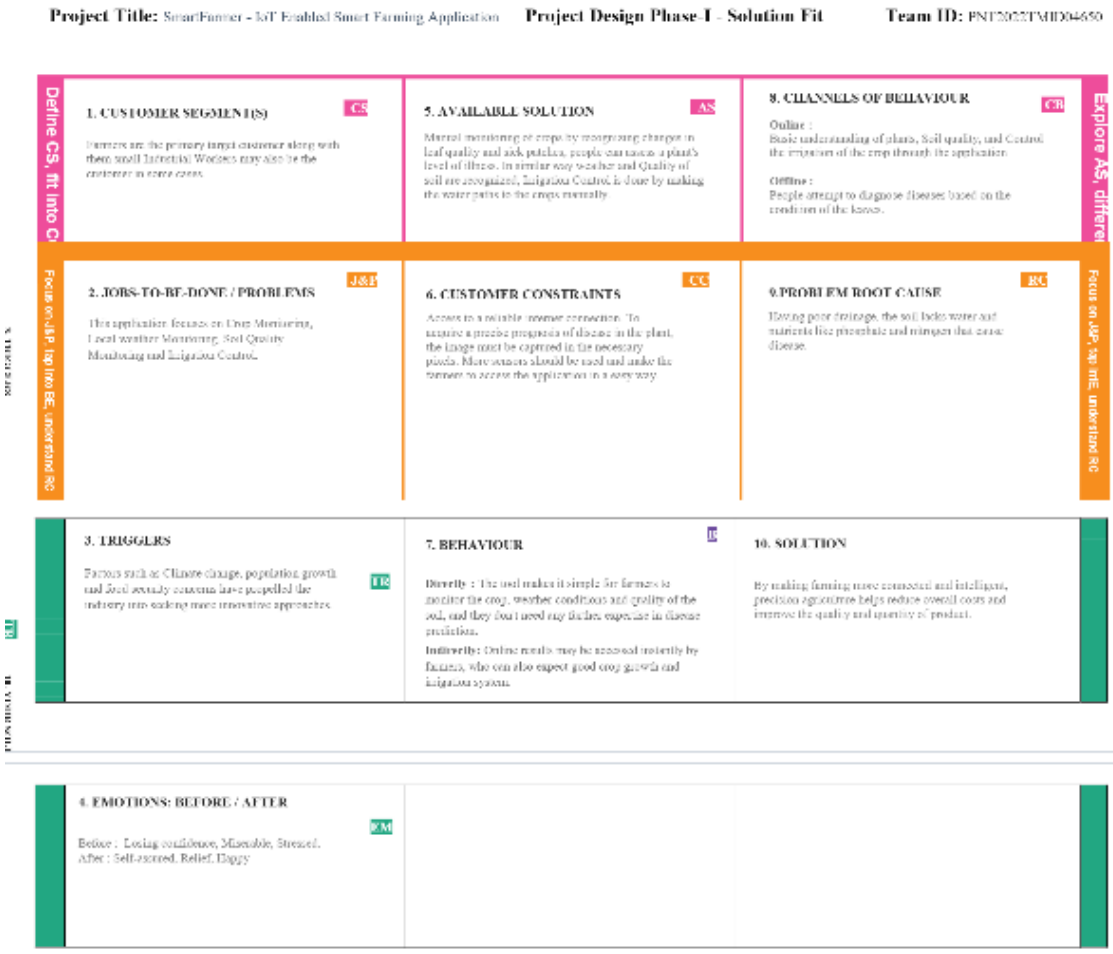
S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To overcome the lack of awareness and control of soil parameters such as temperature, moisture, humidity thereby improving quality of crops and plants, by implementing automated watering of plants.
	Idea / Solution description	To provide clear awareness about the Farming and crops

2.	soil, crop, weather parameters and improving controllability of the farming process through remote monitoring using sensors and controlling using an application.	
3.	Novelty / Uniqueness	• Usage of Raspberry Pi for increased processing power and user-friendly programming using Python. • Usage of Servo motors to properly direct the water flow according to the needs.
4.	Social Impact / Customer Satisfaction	• Improvisation in control of farming which ultimately leads to increased number of plants and trees. • Effective reduction of greenhouse effect and global warming.
5.	Business Model (Revenue Model)	Based on the scale of application and the sophistication of the motors, the cost of the model will vary.
6.	Scalability of the Solution	Variables of the entire field can be monitored using a single cloud account.

Small scale farming (gardening) applications for domestic purposes can use small scale model and largescale farming can include more sophisticated sensors such as rain sensor, TDS sensor, etc.



3.1 Problem Solution fit



CHAPTER 4 - REQUIREMENT ANALYSIS

4.1 Functional Requirements:

Functional requirements involve the hardware and software components needed to design the system. They are:

- ***Sensors***: Rain sensor, DHT11–Temperature and Humidity sensor, Soil Moisture sensor.
- ***Actuators***: Water pumps, Motors, Servos.
- ***MCUs (Microcontroller Units)***: Raspberry Pi, ESP-8266.
- ***Software Components***: Web UI, Node red, IBM Watson as the cloud platform, Mobile application using MIT App inventor.

4.2 Non-functional Requirements:

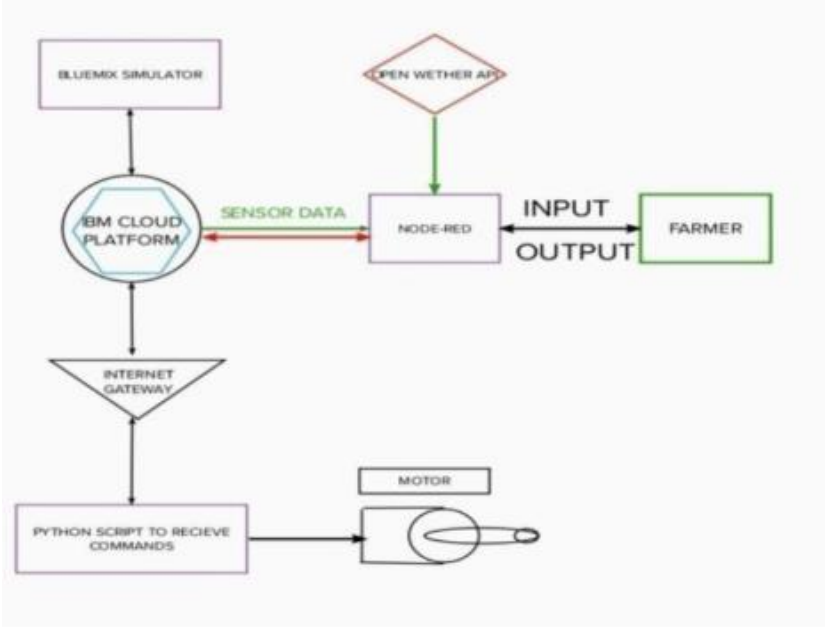
Non-functional requirements deal more of a customer or business model point of view. These requirements play a major role when the project is ready as a market product. Some of those non-technical requirements are:

- ***Usability***: Can be used for both large scale agricultural farms and domestic gardens for soil monitoring and watering of plants.
- ***Security***: Since the user uses his/her own cloud account to store and process sensor data, data privacy is maintained to a significant extent.
- ***Reliability***: Inclusion of real-time monitoring of sensor data and interactive mobile application makes the product more reliable.

- ***Performance***: Performance of the system is significantly high as MCUs with high processing capability such as Raspberry Pi are being used.
- ***Availability***: After successful completion of the design, the model will be available in the market, and people can purchase the product according to their requirements.
- ***Scalability***: The design can be scaled to be used for large sized farms by including sophisticated hardware components and sensors like TDS sensor, according to the requirements and physical parameters.

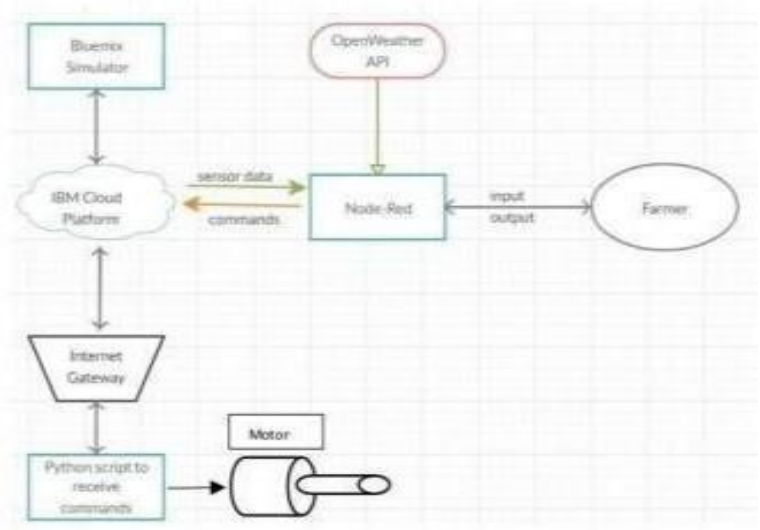
CHAPTER 5 - PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution and Technical Architecture

The technical architecture diagram is as follows:



Guidelines:

1. Include all the processes (As an application logic / Technology Block)
2. Provide infrastructural demarcation (Local/ Cloud)
3. Indicate external interfaces (third party API's etc.)
4. Indicate Data Storage components /services 5. Indicate interface to machine learning models (if applicable)

- The different soil parameters temperature, soil moistures and humidity are sensed using different sensors and obtained value is stored in the IBM cloud.
- Here, instead of using Raspberry Pi processor unit, random values are generated for various soil parameters using Python.
- NODE-RED is used as a programming tool to write the hardware, software, and APIs. The MQTT protocol is followed for the communication.
- All the collected data are provided to the user through a mobile application that was developed using the MIT app inventor. The user could decide through an app, weather to water the crop or not

depending upon the sensor values. By using the app, they can remotely operate the motor switch.

5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard					
Customer (Web user)						
Customer Care Executive						
Administrator						

CHAPTER 6 - PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning and Estimation

6.2 Sprint Delivery and Schedule

The Sprint schedule is as follows:

Sprint	Functional requirement (epic)	User story number	User story/task	Story points	priority	Team members
Sprint-1	Registration	USN-1	As a user the farmer hast to register the user authentication	20	high	Chandhuru A

			details to the app			
Sprint-1	Registration	USN-2	Then he/she will get conformation mail for the authentication	20	High	Murugaraj K
Sprint-2	Login	USN-3	He/she can monitor the field whether the moisture level is down	10	Low	Bavaneshvar B
Sprint-3	Dashboard	USN-4	If moisture level is down thermistor sensor detect it and send the message through cloud	15	Medium	Dhanush kumar B
Sprint-4	Dashboard	USN-5	Then they will get message from the app	20	high	Chandhuru A

Project Tracker, Burndown chart:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let us calculate the team's average velocity (AV) per iteration unit (storage points per day).

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

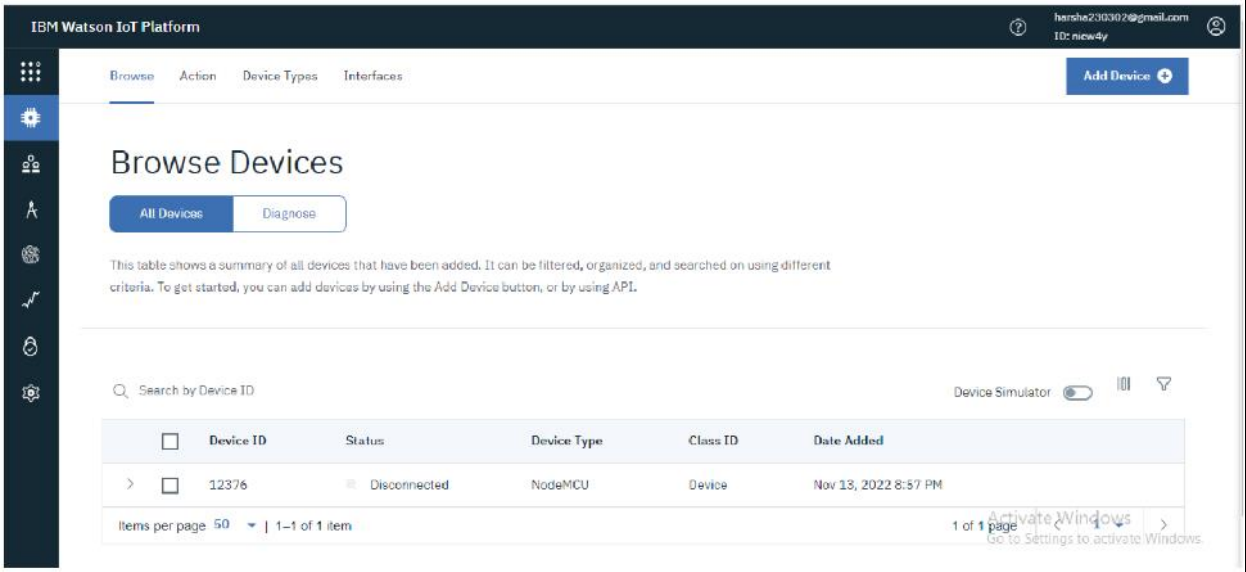
Burndown Chart:

A burndown chart is the graphical representation of work left to be done versus time. It is often used in agile software development methodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

CHAPTER 7 - CODING AND SOLUTIONING

- **Configuration of the IBM Watson IOT Platform and a device:**

In the IBM Watson IOT Platform, under the catalog list, under the Internet of Things platform, a device has been created. From that the device credentials such as Device ID, Device Type, Organization ID, Authentication token were obtained.



- **Development of Python Script to publish data to IBM Watson IOT platform:**

Code:

```
import time
import sys import
ibmiotf.application
import ibmiotf.device
import random
#Provide your IBM
Watson Device
Credentials
```

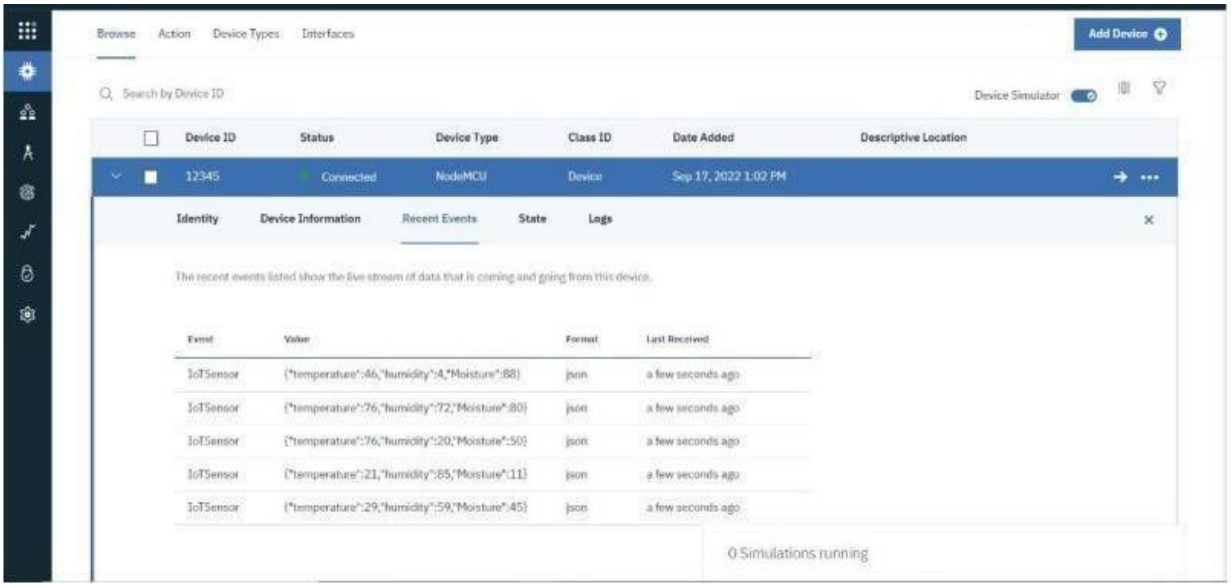
```
organization =
"nicw4y"  deviceType
=
"NodeMcu"
deviceId = "12376" authMethod = "token" authToken = "harsha@23" # Initialize GPIO try: deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod, "auth-token": authToken}
```

```
        deviceCli = ibmiotf.device.Client(deviceOptions)
        #.....except Exception as e:
print("Caught exception connecting device: %s" % str(e))  sys.exit()
# Connect and send a datapoint "hello" with value "world" into the cloud
as # an event of type "greeting" 10 times deviceCli.connect() while True:
#Get Sensor Data from DHT11 temp=random.randint(0,100)
pulse=random.randint(0,100) moisture= random.randint(0,100)
humidity=random.randint(0,100);  lat = 17  lon = 18  data = { 'temperature'
: temp, 'humidity' : humidity, 'Moisture' :
        moisture}  #print
        data

def myOnPublishCallback():
        print ("Published Temperature = %s C" % temp, "Humidity = %s
        %%" % humidity, "Soil Moisture = %s %%" % moisture,"to IBM
        Watson")   success = deviceCli.publishEvent("IoTSensor", "json",
data, qos=0, on_publish=myOnPublishCallback) if not success:
print("Not connected to IoTF")
time.sleep(1)  deviceCli.commandCallback =
myCommandCallback  # Disconnect the device and application
from the cloud  deviceCli.disconnect()
```

Python Code Output:

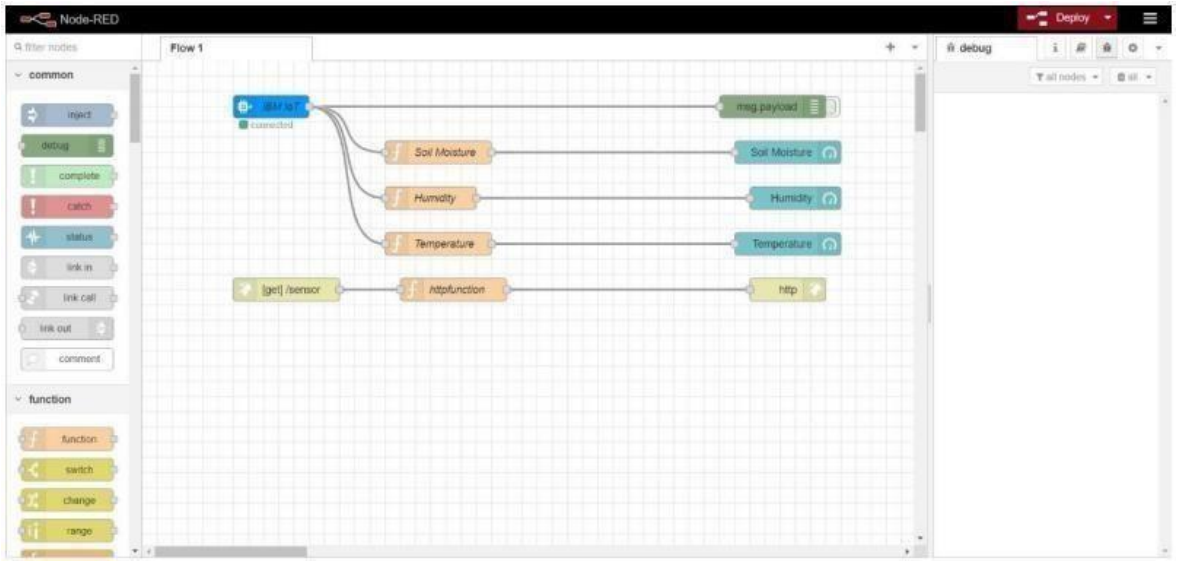
```
*Python 3.7.0 Shell*
File  Edit  Shell  Debug  Options  Window  Help
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
========= RESTART: C:\Users\manoj-pt5890\Documents\python\project.py =========
2022-11-11 17:28:32,248   ibmiotf.device.Client      INFO    Connected successfully: d:nckdv7:NodeMCU:12345
Published Temperature = 89 C Humidity = 70 % Soil Moisture = 3 % to IBM Watson
Published Temperature = 78 C Humidity = 5 % Soil Moisture = 2 % to IBM Watson
Published Temperature = 85 C Humidity = 61 % Soil Moisture = 34 % to IBM Watson
Published Temperature = 75 C Humidity = 83 % Soil Moisture = 23 % to IBM Watson
Published Temperature = 72 C Humidity = 34 % Soil Moisture = 70 % to IBM Watson
Published Temperature = 38 C Humidity = 36 % Soil Moisture = 48 % to IBM Watson
Published Temperature = 62 C Humidity = 36 % Soil Moisture = 35 % to IBM Watson
Published Temperature = 34 C Humidity = 64 % Soil Moisture = 29 % to IBM Watson
Published Temperature = 95 C Humidity = 40 % Soil Moisture = 100 % to IBM Watson
Published Temperature = 47 C Humidity = 95 % Soil Moisture = 58 % to IBM Watson
```

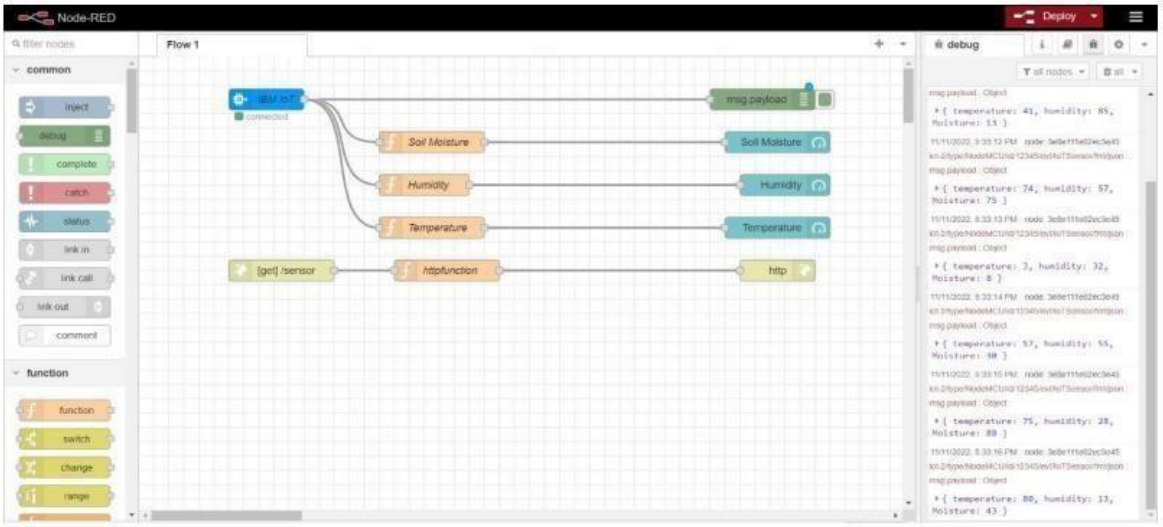
IBM Cloud after publishing data:



- **Creation of Node Red Service for device events:**

  In the IBM Watson IOT platform, under the catalog, under the Node Red app service, an application is deployed using cloud foundry. In the cloud foundry, a group has been created and using the ci pipeline, the app url is obtained. Using the URL, the Node red is launched. The IBM Watson IOT platform is connected to Node red using the IBM IoT palette. Using appropriate palettes, the data published in the IBM IoT platform is printed in the debug window of Node red.





Code block for the function palette:

1) **<u>Soil moisture</u>:**

Soil = msg.payload.Moisture msg.payload = "Soil Moisture : " global.set('m',Soil)

msg.payload = Math.round(Soil)return msg;

2) **<u>Humidity:</u>**

Humidity = msg.payload.humidity msg.payload = "Humidity : "

global.set('h',Humidity) msg.payload

= Math.round(Humidity) return msg; **3)**

Temperature:

Temperature = msg.payload.temperature msg.payload

= "Temperature : " global.set('t',Temperature)

msg.payload

=Math.round(Temperature) return msg; **4)**

HTTP Function:

msg.payload = {"Temperature:": global.get('t'),"Humidity:":

global.get('h'),"Soil Moisture:": global.get('m')} return msg;

- **Creation of Website dashboard:**

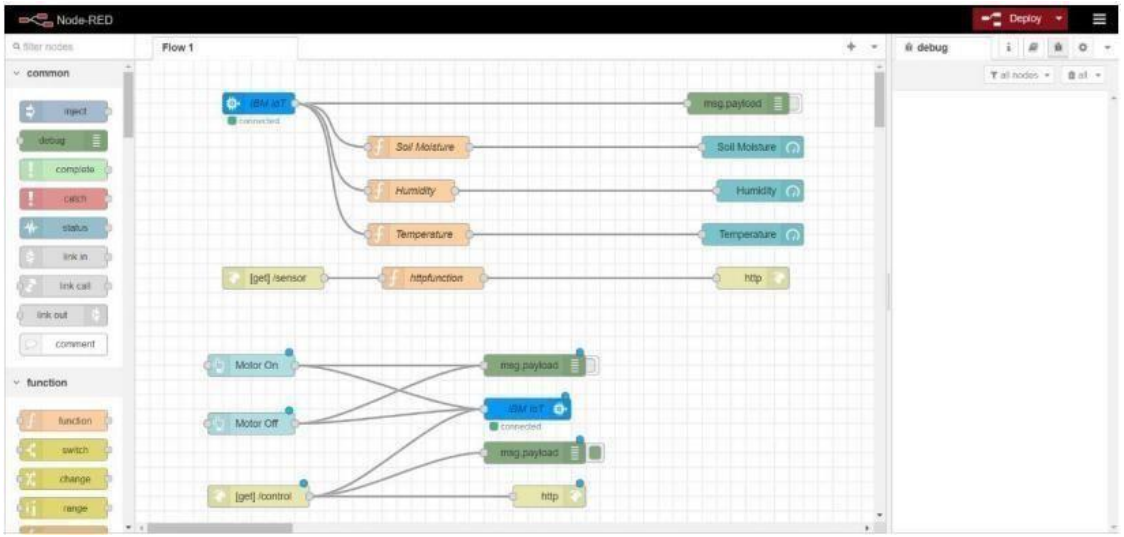
A website dashboard has been created using the gauge palette. It can be accessed by adding "/ui" in the main url of Node red. This dashboard displays the gauge representation of the data published in the IBM IOT platform.

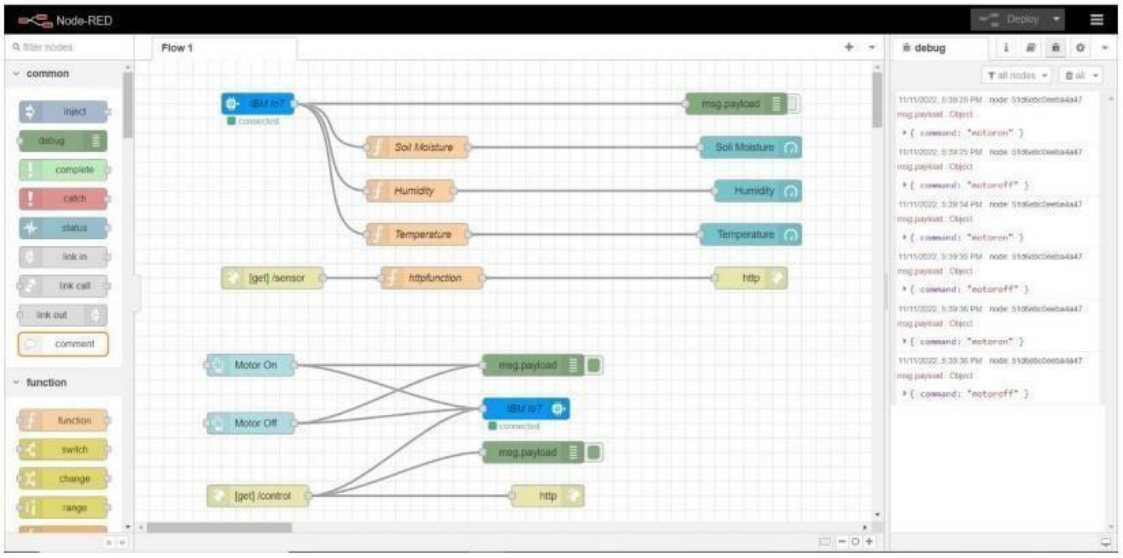
Python code used:

```
importtime import sys
import ibmiotf.application
import ibmiotf.device
import random
#Provide your IBM Watson Device Credentials
organization = "nicw4y" deviceType = "NodeMcu"
deviceId = "12376"  authMethod
= "token" authToken = "harsha@23" #Initialize
GPIO  try:
deviceOptions = {"org": organization, "type": deviceType,"id":
deviceId, "auth-method": authMethod, "auth-token": authToken}
deviceCli      = ibmiotf.device.Client(deviceOptions)
#..... except
Exception as e:  print("Caught exception connecting device: %s" %
str(e))  sys.exit()
# Connect and send a datapoint "hello" with value "world" into the
cloud as an event of type "greeting" 10 times deviceCli.connect() while
True: #Get Sensor Data from DHT11 temp=random.randint(0,100)
                                        pulse=random.randint(0,100)
moisture= random.randint(0,100)
humidity=random.randint(0,100); lat = 17 lon = 18 data = {
'temperature' : temp, 'humidity' :  humidity, 'Moisture' : moisture}
#print                data          def
myOnPublishCallback():
```

print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % humidity, "Soil Moisture = %s %%" %moisture,"to IBM Watson")
success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on_publish=myOnPublishCallback) if not success:
print("Not connected to IoTF")
time.sleep(1) deviceCli.commandCallback = myCommandCallback # Disconnect the device and application from the cloud deviceCli.disconnect() **Creation of Node red service fordevice commands:**

In addition to the palettes used in the Sprint-2, additional palettes such as buttons have been included to control devices by giving commands and the output is printed in the debug whenever a specific command is given.





Development of Python script to subscribe command from the IBM IOT platform:

Code: import time

import sys import

ibmiotf.application

import ibmiotf.device

import random

#Provide your IBM Watson Device Credentials organization = "nicw4y" deviceType = "NodeMcu" deviceId = "12376" authMethod = "token" authToken = "harsha@23" # Initialize GPIO def myCommandCallback(cmd): print("Command received: %s" % cmd.data['command']) status=cmd.data['command'] if status=="motoron":

print("Motor is ON") else:

print("Motor is OFF")

#print(cmd) try: deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "authmethod": authMethod, "auth-token": authToken} deviceCli = ibmiotf.device.Client(deviceOptions)

..... except

Exception as e:

print("Caught exception connecting device: %s" % str(e)) sys.exit()

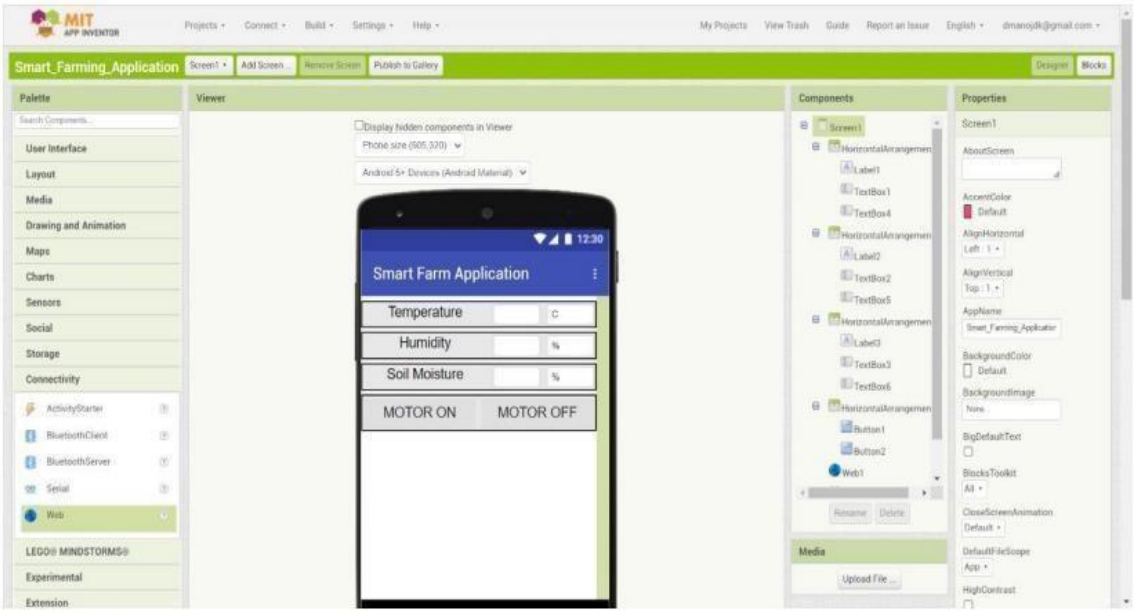
Connect and send a datapoint "hello" with value "world" into the cloud as # an event of type "greeting" 10 times deviceCli.connect() while True: #Get Sensor Data from DHT11 temp=random.randint(0,100) pulse=random.randint(0,100) moisture= random.randint(0,100) humidity=random.randint(0,100); lat = 17 lon = 18 data = { 'temperature' : temp, 'humidity' : humidity, 'Moisture' :

```
moisture}  #print
data

def myOnPublishCallback():

print ("Published Temperature = %s C" % temp, "Humidity = %s
%%" % humidity, "Soil Moisture = %s %%" % moisture,"to IBM
Watson")  success = deviceCli.publishEvent("IoTSensor",
"json", data, qos=0,      on_publish=myOnPublishCallback) if not
success:
print("Not connected to IoTF")       time.sleep(1)
 deviceCli.commandCallback            =
myCommandCallback # Disconnect the device and
application from the cloud deviceCli.disconnect()
```

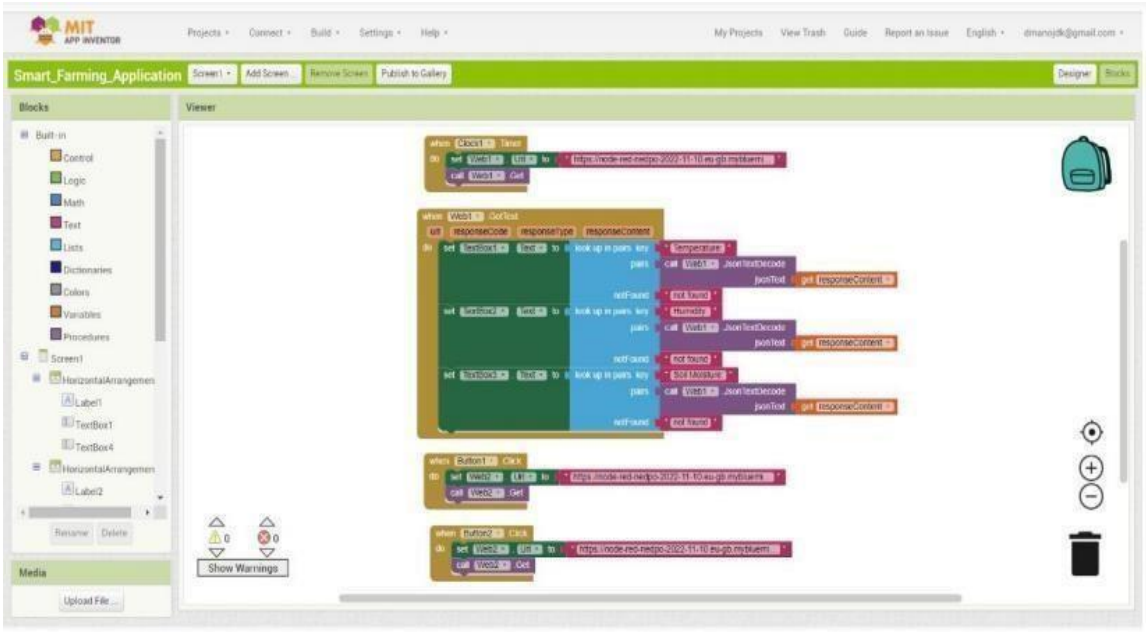
Output:

```
Published Temperature = 93 C Humidity = 81 % Soil Moisture = 87 % to IBM Watson
Command received: motoron
Motor is ON
Command received: motoroff
Motor is OFF
Published Temperature = 54 C Humidity = 36 % Soil Moisture = 81 % to IBM Watson
Published Temperature = 56 C Humidity = 76 % Soil Moisture = 56 % to IBM Watson
Published Temperature = 70 C Humidity = 53 % Soil Moisture = 74 % to IBM Watson
Published Temperature = 58 C Humidity = 22 % Soil Moisture = 68 % to IBM Watson
Command received: motoron
Motor is ON
Published Temperature = 93 C Humidity = 34 % Soil Moisture = 11 % to IBM Watson
Command received: motoroff
Motor is OFF
Published Temperature = 86 C Humidity = 67 % Soil Moisture = 38 % to IBM Watson
Published Temperature = 49 C Humidity = 70 % Soil Moisture = 61 % to IBM Watson
Published Temperature = 94 C Humidity = 48 % Soil Moisture = 77 % to IBM Watson
Published Temperature = 59 C Humidity = 6 % Soil Moisture = 11 % to IBM Watson
Published Temperature = 16 C Humidity = 6 % Soil Moisture = 41 % to IBM Watson
```

MIT App Front End:



Backend:



App working:

The app works based on HTTP protocol. The app uses HTTP GET method to parse the JSON data from the Node red website and displays the value in the UI. Using the HTTP POST method, the app sends command when a specific button is pressed. From where, the python code subscribes the command data from the cloud thereby notifying the command is received.

Python code: import time

import sys import

ibmiotf.application

import ibmiotf.device

import random

#Provide your IBM Watson Device Credentials organization = "nicw4y" deviceType = "NodeMcu" deviceId = "12376" authMethod = "token" authToken = "harsha@23" # Initialize GPIO def myCommandCallback(cmd): print("Command received: %s" % cmd.data['command']) status=cmd.data['command'] if status=="motoron": print("Motor is ON") else:

print("Motor is OFF")

#print(cmd)

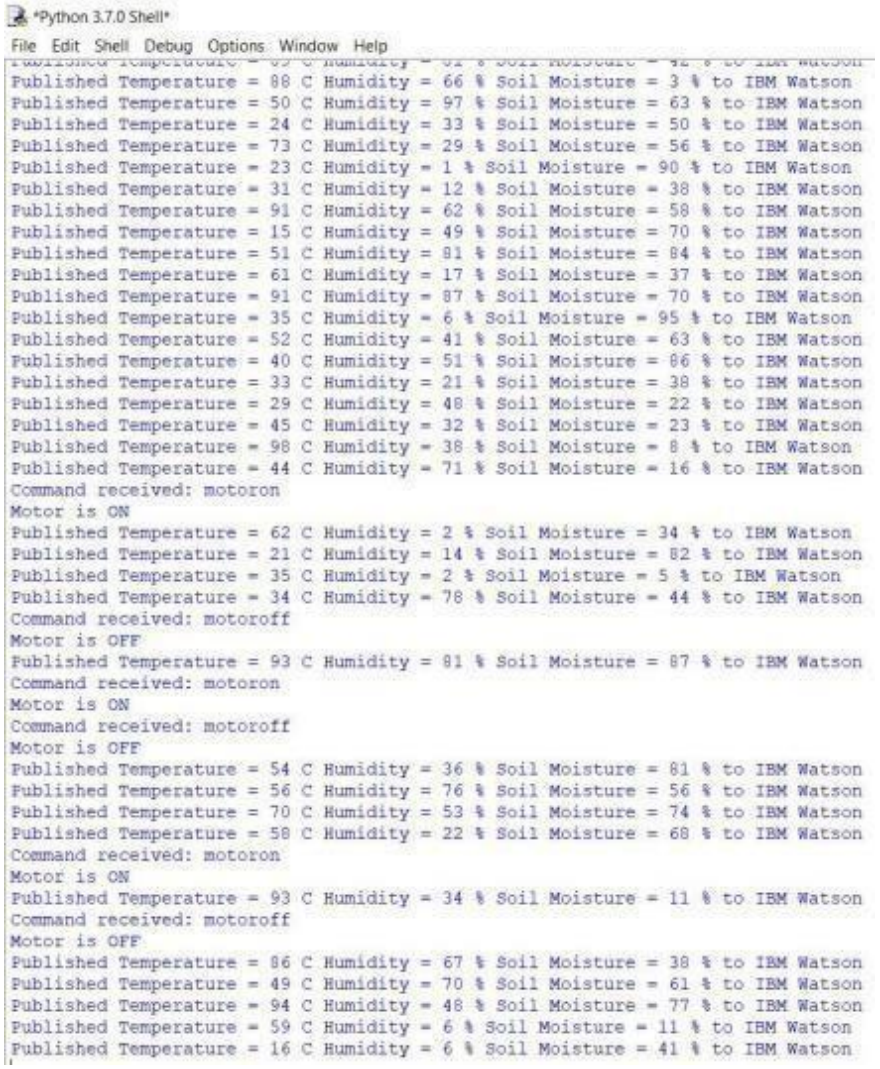
try: deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod, "auth-token": authToken} deviceCli = ibmiotf.device.Client(deviceOptions) #..... except Exception as e: print("Caught exception connecting device: %s" % str(e))

sys.exit()

Connect and send a datapoint "hello" with value "world" into the cloud as # an event of type "greeting" 10 times deviceCli.connect() while True: #Get Sensor Data from DHT11 temp=random.randint(0,100) pulse=random.randint(0,100) moisture= random.randint(0,100) humidity=random.randint(0,100); lat = 17 lon = 18 data = { 'temperature' : temp, 'humidity' : humidity, 'Moisture' :

```
        moisture}
        #print        data        def
myOnPublishCallback():
        print ("Published Temperature = %s C" % temp, "Humidity = %s
          %%" % humidity, "Soil Moisture = %s %%" % moisture,"to
IBM         Watson") success = deviceCli.publishEvent("IoTSensor",
"json", data, qos=0,  on_publish=myOnPublishCallback)  if not success:
print("Not connected to IoTF")  time.sleep(1)
deviceCli.commandCallback = myCommandCallback #
Disconnect the device and application from the cloud
deviceCli.disconnect()
```

Output:


Python 3.7.0 Shell
File Edit Shell Debug Options Window Help
Published Temperature = 88 C Humidity = 66 % Soil Moisture = 3 % to IBM Watson
Published Temperature = 50 C Humidity = 97 % Soil Moisture = 63 % to IBM Watson
Published Temperature = 24 C Humidity = 33 % Soil Moisture = 50 % to IBM Watson
Published Temperature = 73 C Humidity = 29 % Soil Moisture = 56 % to IBM Watson
Published Temperature = 23 C Humidity = 1 % Soil Moisture = 90 % to IBM Watson
Published Temperature = 31 C Humidity = 12 % Soil Moisture = 38 % to IBM Watson
Published Temperature = 91 C Humidity = 62 % Soil Moisture = 58 % to IBM Watson
Published Temperature = 15 C Humidity = 49 % Soil Moisture = 70 % to IBM Watson
Published Temperature = 51 C Humidity = 81 % Soil Moisture = 84 % to IBM Watson
Published Temperature = 61 C Humidity = 17 % Soil Moisture = 37 % to IBM Watson
Published Temperature = 91 C Humidity = 87 % Soil Moisture = 70 % to IBM Watson
Published Temperature = 35 C Humidity = 6 % Soil Moisture = 95 % to IBM Watson
Published Temperature = 52 C Humidity = 41 % Soil Moisture = 63 % to IBM Watson
Published Temperature = 40 C Humidity = 51 % Soil Moisture = 86 % to IBM Watson
Published Temperature = 33 C Humidity = 21 % Soil Moisture = 38 % to IBM Watson
Published Temperature = 29 C Humidity = 48 % Soil Moisture = 22 % to IBM Watson
Published Temperature = 45 C Humidity = 32 % Soil Moisture = 23 % to IBM Watson
Published Temperature = 98 C Humidity = 38 % Soil Moisture = 8 % to IBM Watson
Published Temperature = 44 C Humidity = 71 % Soil Moisture = 16 % to IBM Watson
Command received: motoron
Motor is ON
Published Temperature = 62 C Humidity = 2 % Soil Moisture = 34 % to IBM Watson
Published Temperature = 21 C Humidity = 14 % Soil Moisture = 82 % to IBM Watson
Published Temperature = 35 C Humidity = 2 % Soil Moisture = 5 % to IBM Watson
Published Temperature = 34 C Humidity = 78 % Soil Moisture = 44 % to IBM Watson
Command received: motoroff
Motor is OFF
Published Temperature = 93 C Humidity = 81 % Soil Moisture = 87 % to IBM Watson
Command received: motoron
Motor is ON
Command received: motoroff
Motor is OFF
Published Temperature = 54 C Humidity = 36 % Soil Moisture = 81 % to IBM Watson
Published Temperature = 56 C Humidity = 76 % Soil Moisture = 56 % to IBM Watson
Published Temperature = 70 C Humidity = 53 % Soil Moisture = 74 % to IBM Watson
Published Temperature = 58 C Humidity = 22 % Soil Moisture = 68 % to IBM Watson
Command received: motoron
Motor is ON
Published Temperature = 93 C Humidity = 34 % Soil Moisture = 11 % to IBM Watson
Command received: motoroff
Motor is OFF
Published Temperature = 86 C Humidity = 67 % Soil Moisture = 38 % to IBM Watson
Published Temperature = 49 C Humidity = 70 % Soil Moisture = 61 % to IBM Watson
Published Temperature = 94 C Humidity = 48 % Soil Moisture = 77 % to IBM Watson
Published Temperature = 59 C Humidity = 6 % Soil Moisture = 11 % to IBM Watson
Published Temperature = 16 C Humidity = 6 % Soil Moisture = 41 % to IBM Watson

CHAPTER 8 - PERFORMANCE METRICS

S. No.	Name of the Phase	Tasks Performed	Performance Metrics
1.	Development of Problem Statement	The underlying problem analyzed and a rough idea of the solution was planned	The Problem statement was developed
2.	Ideation Phase	Extracting use and test cases	Empathy map, Ideation and Literature survey were formulated.
3.	Project Design Phase 1	Solution for the problem is formulated and architecture is designed	Problem solution fit was designed and the Proposed solution is finalized with the help of Solution architecture.
4.	Project Design Phase 2	In depth analysis of the solution is performed including requirements, tech stack, etc.	Solution Requirements, Overall Technology stack, Data flow diagrams, User stories were formulated.
5.	Project Planning Phase	Various sprints were designed as individual progressive steps.	Project Milestone and Sprint Plans were developed.

CHAPTER 9 - ADVANTAGES AND DISADVANTAGES

9.1 Advantages:

- By monitoring the soil parameters of the farm, the user can have a complete analysis of the field, in terms of numbers.
- Using the website and the application, an interactive experience can be achieved.
- As the data gets pushed to the cloud, one can access the data anywhere from this world. o Without human intervention, water pump can be controlled through the mobile application and it's flow can be customized using servo motors.
- By using Raspberry Pi MCU, scalability can be increased due to its high processing power and enough availability of GPIO pins

9.2 Disadvantages:

- Data transfer is through the internet. So data fetch and push might delay due to slow internet connection, depending on the location and other physical parameters.
- System can only monitor a certain area of the field. In order to sense and monitor an entire field, sensors should be placed in many places, which may increase the cost.
- Data accuracy may vary according to various physical parameters such as temperature, pressure, rain.
- Cost of the system is high due to usage of Raspberry Pi. o Rodent and insects may cause damage to the system.

CHAPTER 10 – CONCLUSION

The project thus monitors important parameters present in the field such as temperature, humidity, soil moisture etc., and controls important actuators such as motors etc. It is helpful for farmers to remotely monitor their fields even during adverse weather conditions and help them control farming equipments remotely using cloud.

CHAPTER 11 - FUTURE SCOPE

The project can be further extended by monitoring other parameters such as nutrient contents in the soil, soil texture etc. AI techniques integrated with cloud can be integrated to monitor any pest attacks present in the plant. The application can be made interactive which provides suggestions to farmers to improve their farmlands.

CHAPTER 12 – APPENDIX

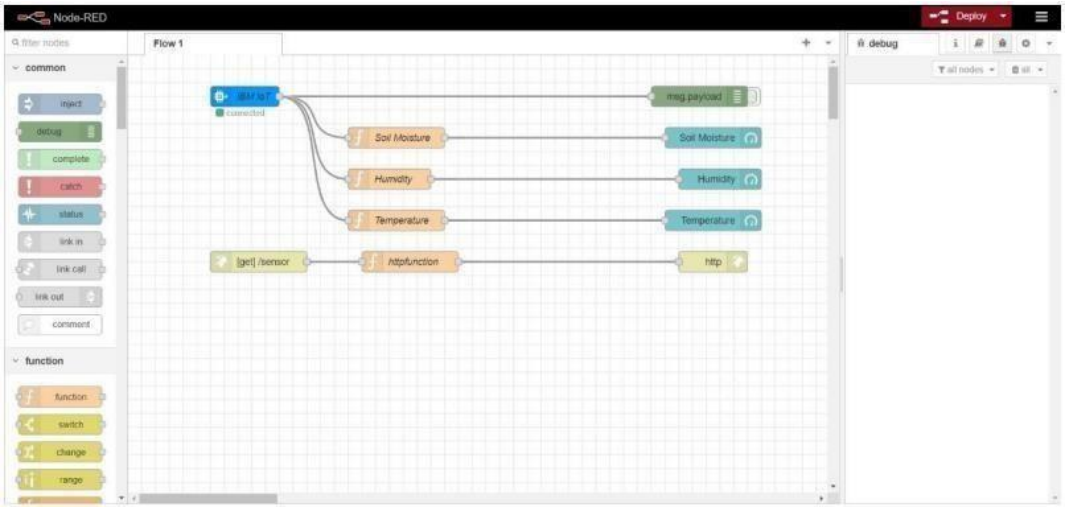
12.1 Source Code:

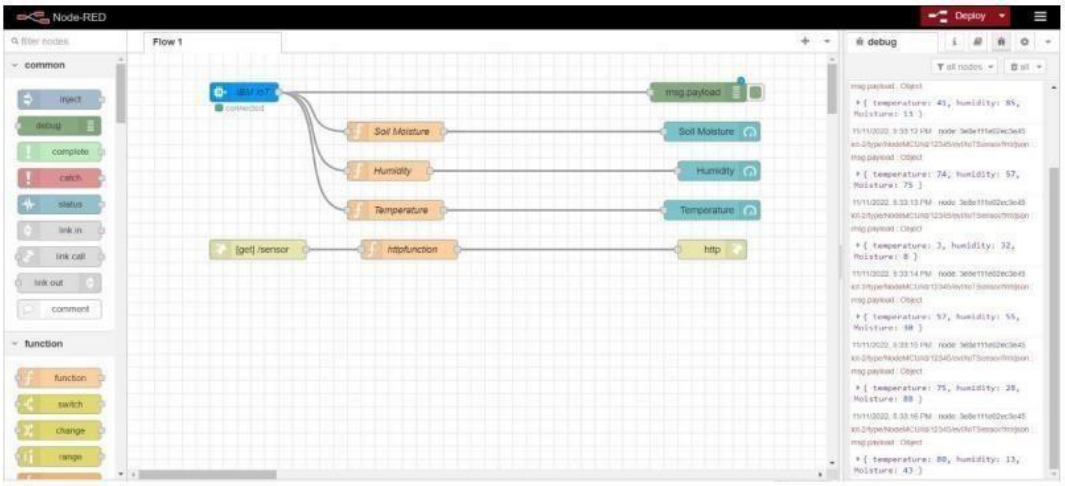
```
import time import
        sys     import
ibmiotf.application import
ibmiotf.device      import
random

#Provide your IBM Watson Device
Credentials organization = "nicw4y"
deviceType = "NodeMcu" deviceId =
"12376" authMethod = "token" authToken =
"harsha@23"

# Initialize GPIO def myCommandCallback(cmd):
print("Command received: %s" % cmd.data['command'])
status=cmd.data['command']          if status=="motoron":
print("Motor is ON")      else:          print("Motor is OFF")
#print(cmd) try: deviceOptions = {"org": organization, "type":
deviceType, "id":
deviceId, "auth-method": authMethod, "auth-token":
authToken}          deviceCli          =
ibmiotf.device.Client(deviceOptions)
        #.....

except Exception as e:
```

```
        print("Caught exception connecting device: %s" % str(e))
sys.exit()

# Connect and send a datapoint "hello" with value "world" into the
cloud as an event of type "greeting" 10 times deviceCli.connect()

while True:
      #Get Sensor Data from DHT11
temp=random.randint(0,100)
pulse=random.randint(0,100)
moisture=     random.randint(0,100)
humidity=random.randint(0,100);
lat =  17        lon = 18

      data = { 'temp' : temp, 'humidity' : humidity, 'Soil Moisture' :
moisture}
      #print data        def myOnPublishCallback():
         print ("Published Temperature = %s C" % temp, "Humidity
= %s %%" % humidity, "Soil Moisture = %s %%" % moisture,"to
IBM Watson")

      success = deviceCli.publishEvent("IoTSensor", "json", data,
qos=0, on_publish=myOnPublishCallback)        if not success:
print("Not connected to IoTF")        time.sleep(1)

      deviceCli.commandCallback = myCommandCallback
```

# Disconnect the device and application from the cloud
deviceCli.disconnect()

Node Red Service Creation:





Code block for the function palette:

1) Soil moisture:

Soil = msg.payload.Moisture

msg.payload = "Soil Moisture : "

global.set('m',Soil) msg.payload =

Math.round(Soil) return msg; **2) Humidity:**

Humidity = msg.payload.humidity msg.payload = "Humidity : " global.set('h',Humidity) msg.payload = Math.round(Humidity) return msg; **3)**

Temperature:

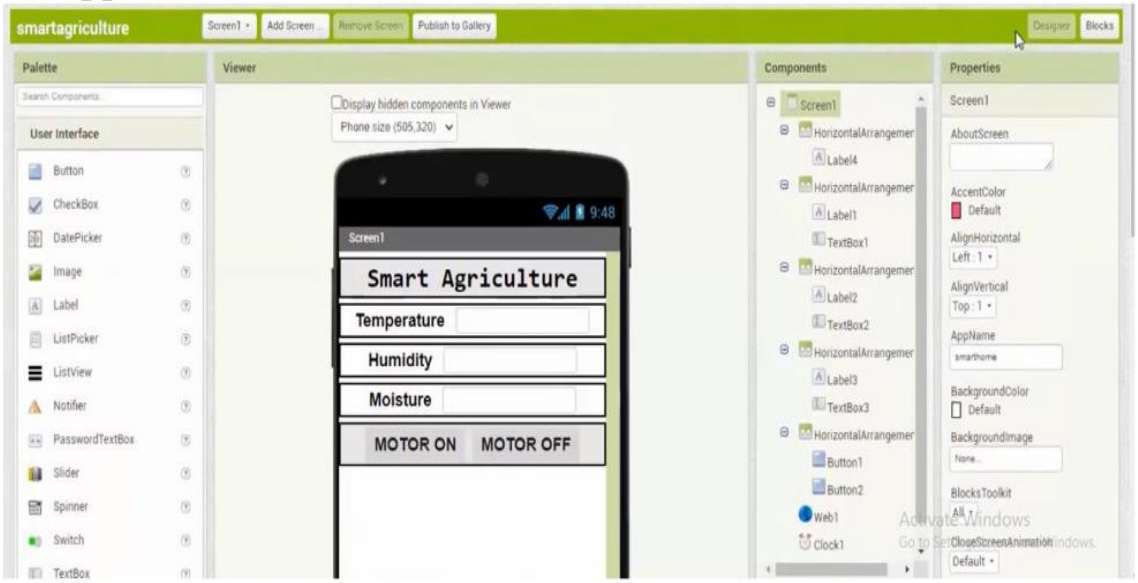
Temperature = msg.payload.temperature msg.payload = "Temperature : " global.set('t',Temperature) msg.payload =Math.round(Temperature) return msg; **4)**

HTTP Function:

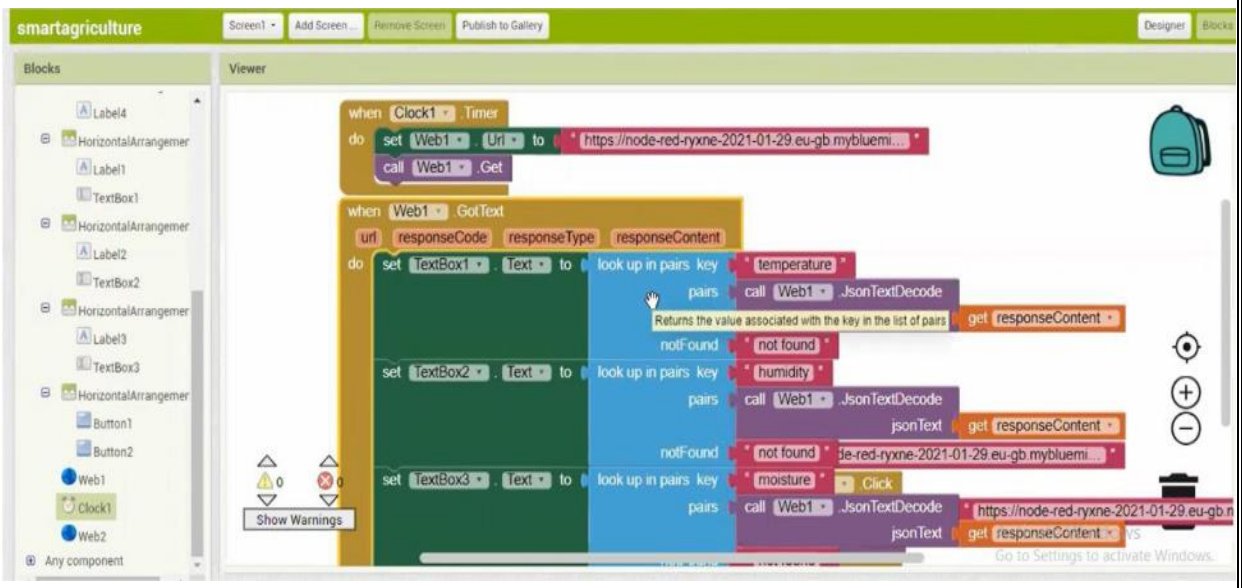
msg.payload = {"Temperature:": global.get('t'),"Humidity:": global.get('h'),"Soil Moisture:": global.get('m')}

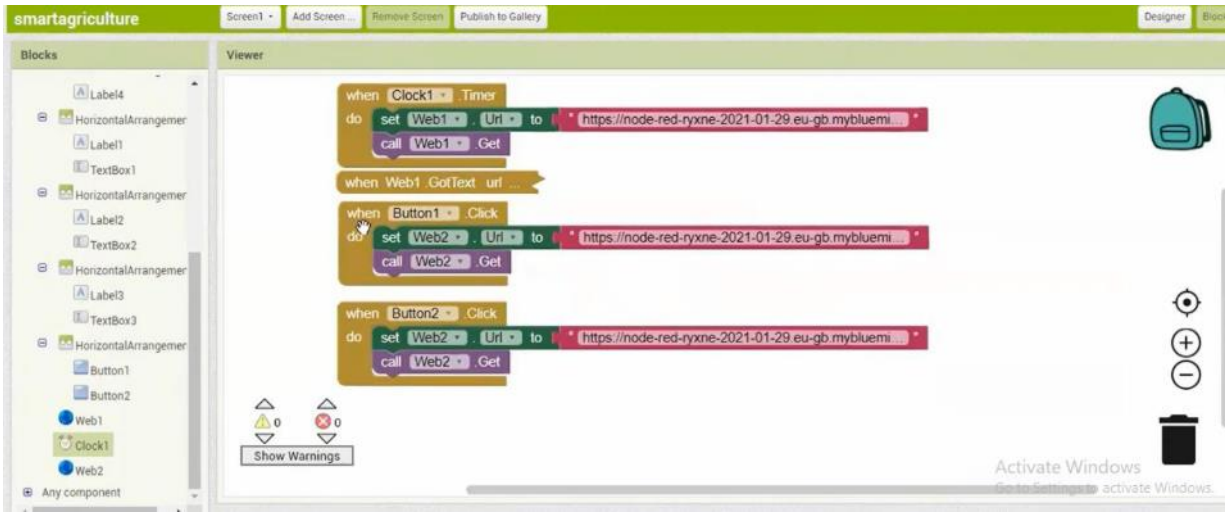
return msg;

MIT App Front End:



Backend:





12.2 GitHub and Project Demo Link:

GitHub source code link:

https://github.com/IBM-EPBL/IBM-Project-22317-1659848832/blob/main/Final%20Delivarables/PNT2022TMID04650-Source_code.py